01-07-00

Case Docket No. PHB 34,314

THE COMMISSIONER OF PATENTS AND TRADEMARKS, Washington, D.C. 20231

Enclosed for filing is the patent application of Inventor(s):
MATTHEW P.J. BAKER, TIMOTHY J. MOULSLEY, BERNARD HUNT

For: RADIO COMMUNICATION SYSTEM

***ENCLOSED ARE:***

[X] Appointment of Associates;
[X] Information Disclosure Statement, Form PTO-1449 and copies of documents listed therein;
[X] Preliminary Amendment;
[X] Specification (15 Pages of Specification, Claims, & Abstract);
[X] Declaration and Power of Attorney:
(2 Pages of a [X]fully executed [ ]unsigned Declaration);
[X] Drawing (3 sheets of [ ]informal [ ]formal sheets);
[X] Certified copy of GREAT BRITAIN applications Serial Nos. 9900910.2, 9911622.0, 9915569.9, 9922575.7;
[X] Authorization Pursuant to 37 CFR §1.136(a)(3)
[ ] Other: ;
[X] Assignment to U.S. PHILIPS CORPORATION.

FEE COMPUTATION

| CLAIMS AS FILED | | | | |
|---|---|---|---|---|
| FOR | NUMBER FILED | NUMBER EXTRA | RATE | BASIC FEE - $690.00 |
| Total Claims | 12 - 20 = | 0 | X $18 = | 0.00 |
| Independent Claims | 4 - 3 = | 1 | X $78 = | 78.00 |
| Multiple Dependent Claims, if any | | | $260 = | 0.00 |
| TOTAL FILING FEE . . . . . . . . . . . . | | | = | $768.00 |

**Please charge Deposit Account No. 14-1270 in the amount of the total filing fee indicated above, plus any deficiencies. The Commissioner is also hereby authorized to charge any other fees which may be required, except the issue fee, or credit any overpayment to Account No. 14-1270.**

[ ]Amend the specification by inserting before the first line as a centered heading --Cross Reference to Related Applications--; and insert below that as a new paragraph --This is a continuation-in-part of application Serial No. , filed , which is herein incorporated by reference--.

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**Natale A. Manzo** — Natale A. Manzo
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of | Atty. Docket
MATTHEW P.J. BAKER ET AL. | PHB 34,314
Serial No. | Group Art Unit
Filed: CONCURRENTLY | Ex.

jc678 U.S. PTO
09/478467
01/06/00

RADIO COMMUNICATION SYSTEM
Honorable Commissioner of Patents and Trademarks
Washington, D.C. 20231

## AUTHORIZATION PURSUANT TO 37 CFR §1.136(a)(3) AND TO CHARGE DEPOSIT ACCOUNT

Sir:

The Commissioner is hereby requested and authorized to treat any concurrent or future reply in this application requiring a petition for extension of time for its timely submission, as incorporating a petition for extension of time for the appropriate length of time.

Please charge any additional fees which may now or in the future be required in this application, including extension of time fees, but excluding the issue fee unless explicitly requested to do so, and credit any overpayment, to Deposit Account No. 14-1270.

Respectfully submitted,

By [signature]
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DESCRIPTION

## RADIO COMMUNICATION SYSTEM

The present invention relates to a radio communication system and further relates to primary and secondary stations for use in such a system and to a method of operating such a system. While the present specification describes a system with particular reference to the emerging Universal Mobile Telecommunication System (UMTS), it is to be understood that such techniques are equally applicable to use in other mobile radio systems.

There are two basic types of communication required between a Base Station (BS) and a Mobile Station (MS) in a radio communication system. The first is user traffic, for example speech or packet data. The second is control information, required to set and monitor various parameters of the transmission channel to enable the BS and MS to exchange the required user traffic.

In many communication systems one of the functions of the control information is to enable power control. Power control of signals transmitted to the BS from a MS is required so that the BS receives signals from different MS at approximately the same power level, while minimising the transmission power required by each MS. Power control of signals transmitted by the BS to a MS is required so that the MS receives signals from the BS with a low error rate while minimising transmission power, to reduce interference with other cells and radio systems. In a two-way radio communication system power control is normally operated in a closed loop manner, whereby the MS determines the required changes in the power of transmissions from the BS and signals these changes to the BS, and vice versa.

An example of a combined time and frequency division multiple access system employing power control is the Global System for Mobile communication (GSM), where the transmission power of both BS and MS transmitters is controlled in steps of 2dB. Similarly, implementation of power

control in a system employing spread spectrum Code Division Multiple Access (CDMA) techniques is disclosed in US-A-5 056 109.

A problem with these known techniques is that at the start of a transmission, or after the transmission is interrupted, the power control loops may take some time to converge satisfactorily. Until such convergence is achieved data transmissions are likely to be received in a corrupted state if their power level is too low, or to generate extra interference if their power level is too high.

An object of the present invention is to address the above problem.

According to a first aspect of the present invention there is provided a radio communication system comprising a primary station and a plurality of secondary stations, the system having a communication channel between the primary station and a secondary station, the channel comprising an uplink and a downlink control channel for transmission of control information, and a data channel for the transmission of data, wherein power control means are provided for adjusting the power of the control and data channels and means are provided for delaying the initial transmission of the data channel until after the initial transmission of the control channels.

According to a second aspect of the present invention there is provided a primary station for use in a radio communication system having a communication channel between the primary station and a secondary station, the channel comprising an uplink and a downlink control channel for transmission of control information, and a data channel for the transmission of data, wherein power control means are provided for adjusting the power of the control and data channels and means are provided for delaying the initial transmission of the data channel until after the initial transmission of the control channels.

According to a third aspect of the present invention there is provided a secondary station for use in a radio communication system having a communication channel between the secondary station and a primary station, the channel comprising an uplink and a downlink control channel for

transmission of control information, and a data channel for the transmission of data, wherein power control means are provided for adjusting the power of the control and data channels and means are provided for delaying the initial transmission of the data channel until after the initial transmission of the control channels.

According to a fourth aspect of the present invention there is provided a method of operating a radio communication system comprising a primary station and a plurality of secondary stations, the system having a communication channel between the primary station and a secondary station, the channel comprising an uplink and a downlink control channel for transmission of control information, and a data channel for the transmission of data, and at least one of the primary and secondary stations having power control means for adjusting the power of the control and data channels, the method comprising delaying the initial transmission of the data channel until after the initial transmission of the control channels.

The data channel may be either an uplink or a downlink data channel (or both in the case of bidirectional data transmission). The delay in transmission of the data channel may either be predetermined, or chosen dynamically so that the delay in transmission of the data channel is sufficient to enable the power control means to have substantially corrected the difference between initial and target power levels in the control channels.

The use of more than one power control step size is known, for example from JP-A-10224294. However its use in this citation is limited to situations where power control is already established but propagation conditions are fluctuating rapidly. This citation does not address the problem of obtaining rapid convergence of power control at the start of, or after an interruption in, a transmission.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, wherein:

Figure 1 is a block schematic diagram of a radio communication system;

Figure 2 illustrates a conventional scheme for establishing a communication link;

Figure 3 illustrates a scheme for establishing a communication link having a delayed start to data transmission;

Figure 4 is a flow chart illustrating a method for performing power control operations having a variable step size;

Figure 5 is a graph of received signal power (P) in dB against time (T) in ms for different power control algorithms, the solid line indicating results with no power control, the chain dashed line indicating results with power control having a single step size, and the dashed line indicating results with power control having two step sizes; and

Figure 6 is a graph of received signal power (P) in dB against time (T) in ms for different power control algorithms, the solid line indicating results with no power control, the chain dashed line indicating results with power control having a single step size, and the dashed line indicating results with power control having three step sizes.

In the drawings the same reference numerals have been used to indicate corresponding features.

Referring to Figure 1, a radio communication system which can operate in a frequency division duplex mode comprises a primary station (BS) 100 and a plurality of secondary stations (MS) 110. The BS 100 comprises a microcontroller (μC) 102, transceiver means (Tx/Rx) 104 connected to antenna means 106, power control means (PC) 107 for altering the transmitted power level, and connection means 108 for connection to the PSTN or other suitable network. Each MS 110 comprises a microcontroller (μC) 112, transceiver means (Tx/Rx) 114 connected to antenna means 116, and power control means (PC) 118 for altering the transmitted power level. Communication from BS 100 to MS 110 takes place on a downlink frequency channel 122, while communication from MS 110 to BS 100 takes place on an uplink frequency channel 124.

One embodiment of a radio communication system uses a scheme illustrated in simplified form in Figure 2 for establishing a communication link between MS 110 and BS 100. The link is initiated by the MS 110 transmitting a request 202 (REQ) for resources on the uplink channel 124. If it receives the request and has available resources, the BS 100 transmits an acknowledgement 204 (ACK) on the downlink channel 122 providing the necessary information for communication to be established. After the acknowledgement 204 has been sent, two control channels (CON) are established, an uplink control channel 206 and a downlink control channel 208, and an uplink data channel 210 is established for transmission of data from the MS 110 to the BS 100. In some UMTS embodiments there may be additional signalling between the acknowledgement 204 and the establishment of the control and data channels.

In this scheme separate power control loops operate in both uplink 124 and downlink 122 channels, each comprising an inner and an outer loop. The inner loop adjusts the received power to match a target power, while the outer loop adjusts the target power to the minimum level that will maintain the required quality of service (i.e. bit error rate). However, this scheme has the problem that when transmissions start on the control channels 206, 208 and data channel 210 the initial power levels and quality target are derived from open loop measurements, which may not be sufficiently accurate as the channels on which the measurements were made are likely to have different characteristics from the newly initiated channels. The result of this is that data transmissions at the start of the data channel 210 are likely to be received in a corrupted state if they are transmitted at too low a power level, or to generate extra interference if they are transmitted at too high a power level.

One known partial solution to this problem is for the BS 100 to measure the received power level of the request 202 and to instruct the MS 110, within the acknowledgement 204, an appropriate power level for the uplink data transmission 210. This improves matters, but there may still be errors introduced by the temporal separation between the request 202 and the start of the uplink data transmission 210.

Figure 3 illustrates a solution to the problem in which the start of the uplink data transmission 210 is delayed by a time 302 sufficient for the power control to have converged sufficiently to enable satisfactory reception of data transmissions by the BS 100. A delay of one or two frames (10 or 20ms) is likely to be sufficient, although longer delays 302 may be permitted if necessary. The additional overhead in the transmission of extra control information on the control channels 206, 208 is balanced by a reduced Eb/No (energy per bit / noise density) for the user data received by the BS 100 over the data channel 210. The delay 302 could be predetermined or it could be determined dynamically, either by the MS 110 (which could detect convergence by monitoring downlink power control information) or the BS 100.

Figure 4 is a flow chart showing another solution to the problem in which the power control step size is variable. Since the power control error is likely to be greatest at the start of a transmission or after an idle period, the optimum power control step size will be larger than that used for normal operation

The method starts 402 with the beginning of the transmissions of the control channels 206, 208 and the data channel 210 (or the beginning of their retransmission after an interruption). The difference between the received power and target power is then determined at 404. Next the power control step size is tested at 406 to determine whether it is greater than the minimum. If it is the power control step size is adjusted at 408 before adjustment of the power at 410. The change in step size could be deterministic, or based on previous power control adjustments or on some quality measurement. The power control loop then repeats, starting at 404.

In one embodiment it is preferred to set the power control step size initially to a large value, then reduce it progressively until it reaches the value set for normal operation (which may be cell or application specific). Preferably the ratio between successive step sizes is no more than two, to allow for the possibility of correcting errors in transmission or due to other factors. The power control step size could be changed in both uplink 124 and downlink 122 channels.

As an example, consider an initial sequence of power control step sizes (in dB) of: 3.0, 2.0, 1.5, 1.0, 0.75, 0.75, 0.5, 0.5, 0.25, where 0.25dB is the minimum step size. Using this sequence with power control signals every 1ms, an initial error of up to 10dB could be corrected within half a frame (5ms), compared with 2.5 frames using the minimum power control step size of 0.25dB that is normally used. Although as described here the step sizes are symmetric (i.e. the same step sizes are applicable to increases or decreases in power), it is known (for example from US-A-5 056 109) that this is not always appropriate. In a similar example, which would be simpler to implement, the initial step size (e.g. 2dB) is used for a predetermined number of power control commands, after which the step size is reduced (e.g. to 1dB).

The selection of initial step size and the rate of change could be predetermined, or determined dynamically. For example, if the power level adjustment signalled in the acknowledgement 204 is large then the initial step size could be increased. As another example, if the MS 110 is able to determine by other means that it has a moderately high speed relative to the BS 100 a larger step size may be appropriate.

A fixed power control adjustment could be applied at the start of the transmission. This could be done even before receipt of any valid power control command, but the size and direction might be predetermined or determined dynamically, for example, using information such as the rate of change of the channel attenuation derived from receiver measurements. Under some channel conditions this gives an improvement in performance. Increasing the power in this way is particularly suited to the case of re-starting a transmission after an interruption, where the state of the power control loop (e.g. current power level) may be retained from before the interruption. An interruption is a pause or gap in transmission during which time one or more of the control and data channels are either not transmitted or not received (or both), but the logical connection between the BS 100 and MS 110 is maintained. It could be either unintentional, caused by a temporary loss of signal, or deliberate, typically because the MS 110 or BS 100 has no data to

transmit or wishes to perform some other function such as scanning alternative channels.

In rapidly changing fading channels the channel attenuation following a pause in transmission is likely to be uncorrelated with that immediately before the pause. In such a case it may be argued that the optimum value of the initial transmission power after the gap will be equal to its average value (ignoring other slow fading effects like shadowing). This will then minimise the difference between the initial value and the optimum instantaneous value due to channel fluctuations. In practice, in one arrangement the transmission power after the gap is determined from a weighted average of the power over some extended period before the gap. A suitable averaging period would depend on particular conditions but could be of the order of 20 slots (i.e. 20 power control cycles). An additional offset or fixed power adjustment is optionally applied to this initial power level. Optimum values of such offsets for particular circumstances could be determined empirically.

In an alternative arrangement the initial power is determined from a weighted sum of power control commands, rather than measurement of the transmitted power. In this arrangement the change in power (in dB) which would need to be applied after a transmission gap could, for example, be computed recursively in the following way:

$$\Delta P(t) = P_{off} + K_1 \times (\Delta P(t-1) - P_{off}) - K_2 \times PC(t) \times PS(t)$$

where:

$\Delta P(t)$ is the change in power which would be applied after a gap, computed recursively at time $t$, during active transmission;

$\Delta P(0)$ could be initialised to zero;

$P_{off}$ is an additional power offset (which may be zero);

$K_1$ and $K_2$ are empirically determined constants, which could be equal, preferably such that $0 \leq K \leq 1$. The values of these constants can be chosen to reflect the effective averaging period used in calculating the power change;

$PC(t)$ is power control command applied at time $t$; and

$PS(t)$ is the power control step size used at time $t$.

$\Delta P(t)$ is effectively the difference between the current power and a weighted average power, and should be quantised to an available power control step size before it is used.

One example of an embodiment in which the selection of step size is determined dynamically uses the sign of the received power control bits to determine the step size. When the MS 110 starts to receive power control commands it uses the largest available step size, and continues to use this step size until a power control command of opposite sign is received when the step size is reduced. This next step size is used until the sign of the power control commands is reversed, when the step size is again reduced. This process continues until the minimum step size is reached.

Figure 5 is a graph showing the effect of this method in a system having two step sizes available. The graph shows how the received signal power (P) in dB, relative to a target power of 0dB, varies with time (T). The solid line shows the received signal power without use of power control. The variation in received power could for example be due to the motion of the MS 110. The chain-dashed line shows the received power with use of power control having a single step size of 1dB. The dashed line shows the received power with the use of power control in accordance with the above method.

In this method, when use of power control begins, at about 4ms, a larger step size of 2dB is used. Initially the received power is less than the target power, so all the power control commands request an increase in power and the 2dB step size continues to be used. Eventually, at about 6ms, the received power exceeds the target power. Once this happens the sign of the power control command reverses, to request a decrease in power, which also has the effect of reducing the step size to the standard step size of 1dB. This step size then continues to be used in response to subsequent power control commands.

It is apparent from Figure 5 that use of the described method enables the received power to reach its target more rapidly than is possible with a single step size. Once the target has been reached, the reduction in step size to the standard step size enables accurate power control to be maintained.

Such a method enables cases where the initial error is large or the channel is rapidly changing to be handled effectively, as well as cases where convergence is achieved quickly.

The method can also be used with a greater number of available step sizes. Figure 6 shows the same example as Figure 5 with the exception that the dashed line shows the received power with the use of power control having three step sizes, 4dB, 2dB and 1dB, available. Initially a 4dB step size is used, with the result that the power reaches the target much more rapidly than in the previous example. When the sign of the power control command reverses, to request a reduction in power, the step size is reduced to 2dB. When the power control command reverses again, to request an increase in power, the step size reduces to the standard step size of 1dB, where it remains.

A variation of the above method is to continue using the larger step size for one slot after the change in sign of the power control command, which could help to correct any overshoot. However, this is unlikely to have a major impact on the average performance of the method.

Combinations of the techniques described above can readily be used to provide improved results.

Although the description above has examined data transmission on the uplink channel 124, the techniques are equally applicable to data transmission on the downlink channel 122 or to bidirectional transmissions.

Embodiments of the present invention have been described using spread spectrum Code Division Multiple Access (CDMA) techniques, as used for example in UMTS embodiments. However, it should be understood that the invention is not limited to use in CDMA systems. Similarly, although embodiments of the present invention have been described assuming frequency division duplex, the invention is not limited to use in such systems. It may also be applied to other duplex methods, for example time division duplex (although the power control rate in such a system would normally be limited to once per transmission burst).

From reading the present disclosure, other modifications will be apparent to persons skilled in the art. Such modifications may involve other

features which are already known in radio communication systems and component parts thereof, and which may be used instead of or in addition to features already described herein.

In the present specification and claims the word "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. Further, the word "comprising" does not exclude the presence of other elements or steps than those listed.

CLAIMS

1. A radio communication system comprising a primary station and a plurality of secondary stations, the system having a communication channel between the primary station and a secondary station, the channel comprising an uplink and a downlink control channel for transmission of control information, and a data channel for the transmission of data, wherein power control means are provided for adjusting the power of the control and data channels and means are provided for delaying the initial transmission of the data channel until after the initial transmission of the control channels.

2. A system as claimed in claim 1, characterised in that the data channel is an uplink data channel.

3. A system as claimed in claim 1 or 2, characterised in that the delay in transmission of the data channel is predetermined.

4. A system as claimed in claim 1 or 2, characterised in that the delay in transmission of the data channel is sufficient to enable the power control means to have substantially corrected the difference between initial and target power levels in the control channels.

5. A primary station for use in a radio communication system having a communication channel between the primary station and a secondary station, the channel comprising an uplink and a downlink control channel for transmission of control information, and a data channel for the transmission of data, wherein power control means are provided for adjusting the power of the control and data channels and means are provided for delaying the initial transmission of the data channel until after the initial transmission of the control channels.

6. A primary station as claimed in claim 5, characterised in that the delay in transmission of the data channel is predetermined.

7. A primary station as claimed in claim 5, characterised in that the delay in transmission of the data channel is sufficient to enable the power control means to have substantially corrected the difference between initial and target power levels in the control channels.

8. A secondary station for use in a radio communication system having a communication channel between the secondary station and a primary station, the channel comprising an uplink and a downlink control channel for transmission of control information, and a data channel for the transmission of data, wherein power control means are provided for adjusting the power of the control and data channels and means are provided for delaying the initial transmission of the data channel until after the initial transmission of the control channels.

9. A secondary station as claimed in claim 8, characterised in that the delay in transmission of the data channel is predetermined.

10. A secondary station as claimed in claim 8, characterised in that the delay in transmission of the data channel is sufficient to enable the power control means to have substantially corrected the difference between initial and target power levels in the control channels.

11. A method of operating a radio communication system comprising a primary station and a plurality of secondary stations, the system having a communication channel between the primary station and a secondary station, the channel comprising an uplink and a downlink control channel for transmission of control information, and a data channel for the transmission of data, and at least one of the primary and secondary stations having power control means for adjusting the power of the control and data channels, the

method comprising delaying the initial transmission of the data channel until after the initial transmission of the control channels.

12. A method as claimed in claim 11, characterised by the delay in transmission of the data channel being predetermined.

ABSTRACT

**RADIO COMMUNICATION SYSTEM**

A radio communication system has means for ensuring that power control of a communication channel has been established before the transmission of data. This is done by delaying initial transmission of a data channel (either at the start of a transmission or after a pause) until after the initial transmission of control channels. In one embodiment the transmission of a data channel can be delayed until adequate power control has been established. These techniques overcome the problem that data transmissions at the start of a data channel are likely to be corrupted if their power level is too low, or to generate extra interference if their power level is too high.

(Figure 3)

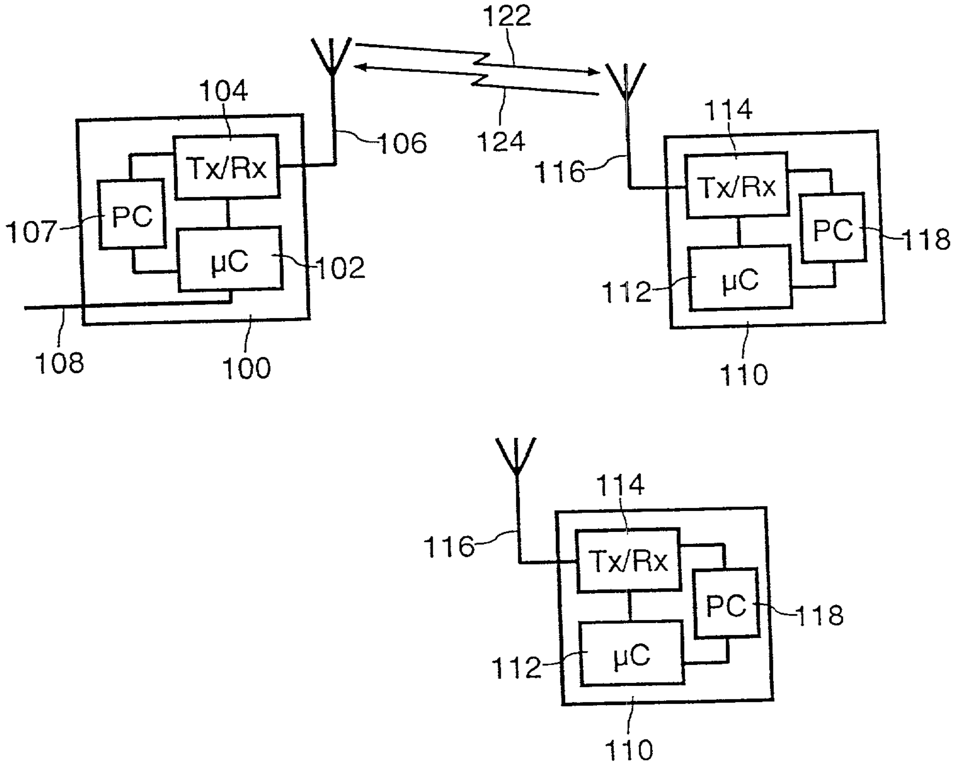
122
104
106
124
114
116
Tx/Rx
107
PC
μC
102
118
112
108
100
110
114
116
Tx/Rx
PC
118
112
μC
110

FIG. 1

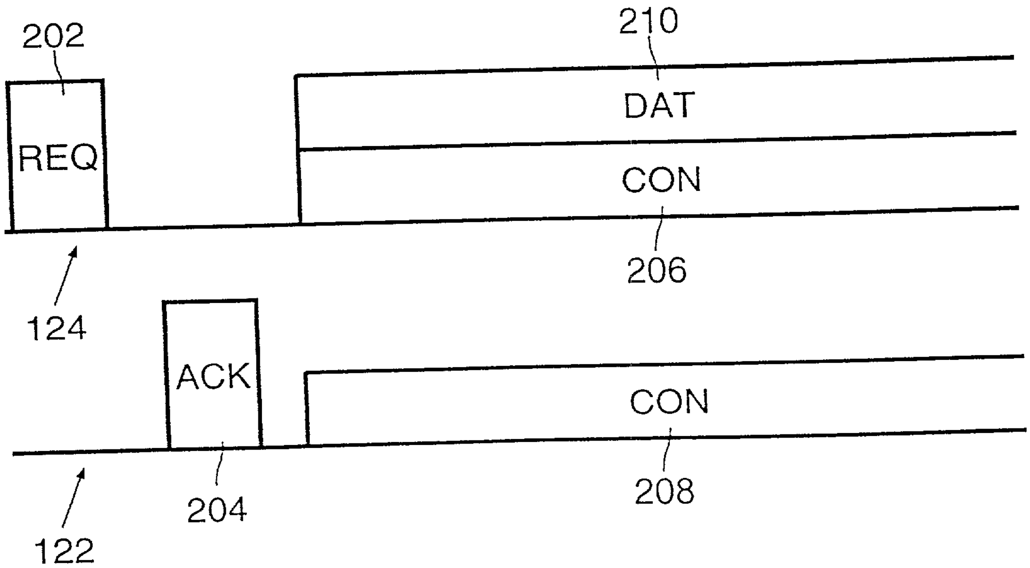
210
202
DAT
REQ
CON
206
124
ACK
CON
204
208
122

FIG. 2

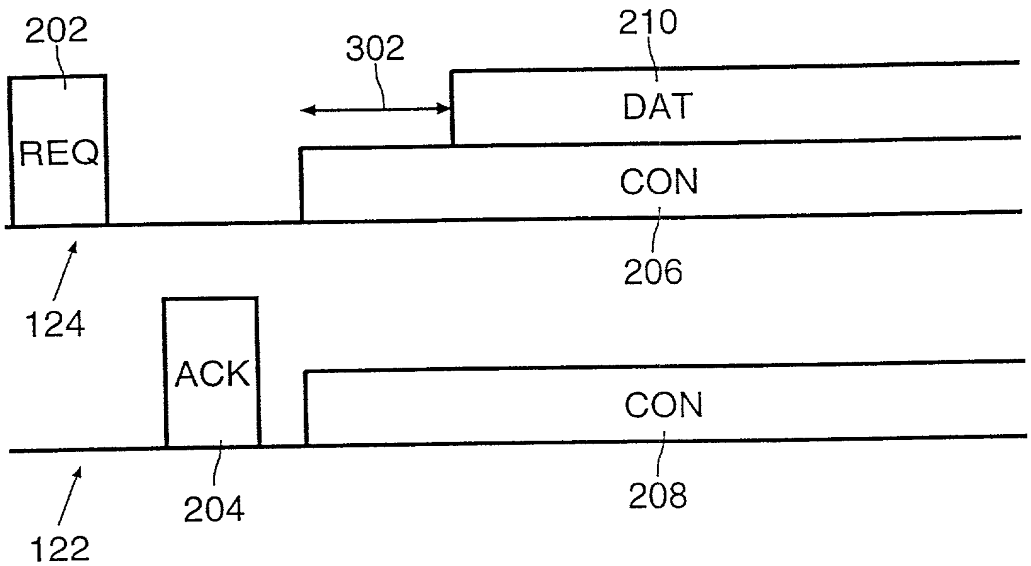
202
302
210
DAT
REQ
CON
206
124
ACK
CON
204
208
122

FIG. 3

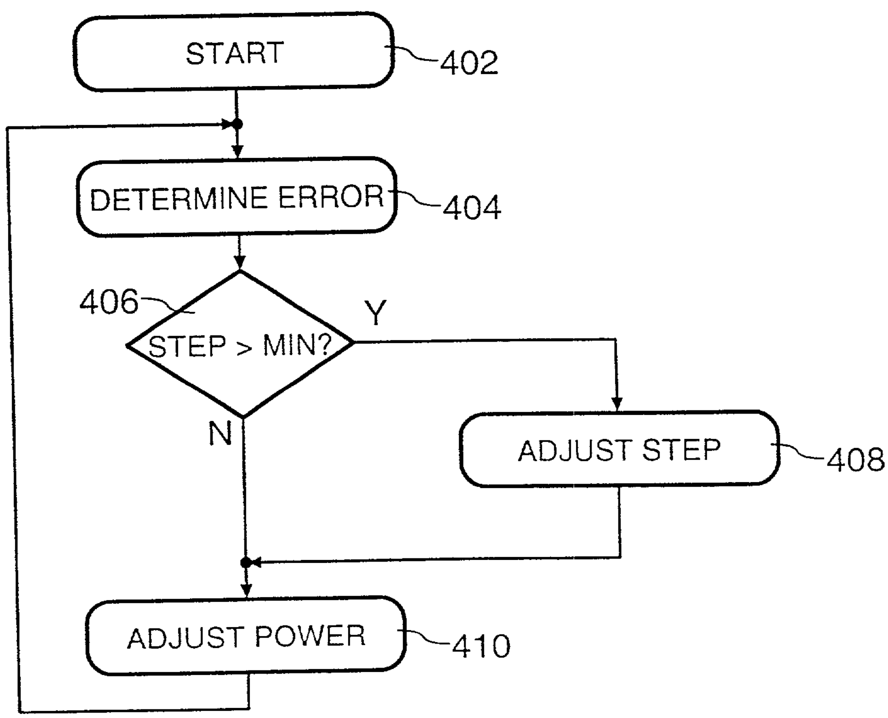
START
402
DETERMINE ERROR
404
406
STEP > MIN?
Y
N
ADJUST STEP
408
ADJUST POWER
410

FIG. 4

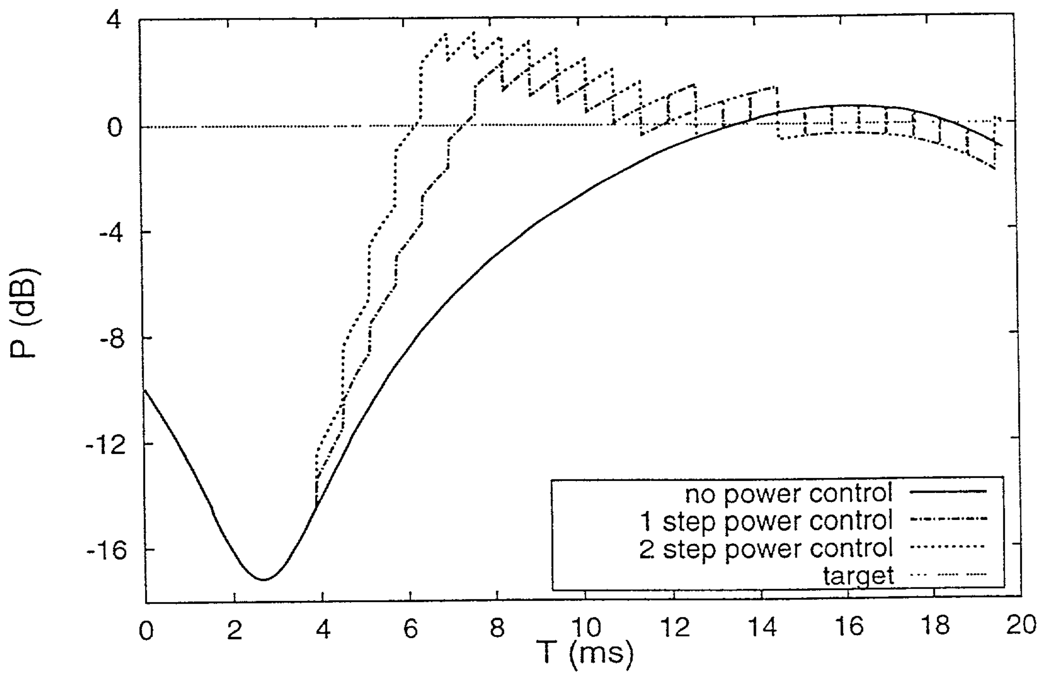
P (dB)
T (ms)
4
0
-4
-8
-12
-16
0
2
4
6
8
10
12
14
16
18
20
no power control
1 step power control
2 step power control
target

FIG. 5

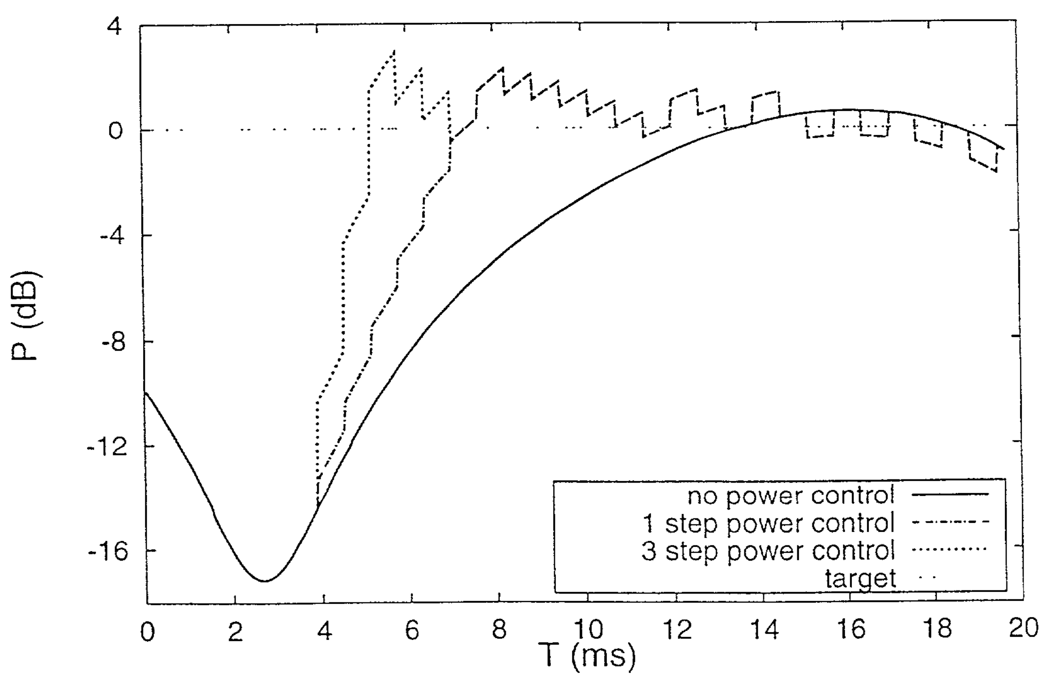
P (dB)
T (ms)
4
0
-4
-8
-12
-16
0
2
4
6
8
10
12
14
16
18
20
no power control
1 step power control
3 step power control
target

FIG. 6

Sole/Joint

Attorney's Docket No: PHB34314US

# DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:
My residence, post office address and citizenship are as stated below next to my name
I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

RADIO COMMUNICATION SYSTEM

the specification of which (check one)

☒ is attached hereto

☐ was filed on as Application Serial No: ........ and was amended on ........ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.
I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56 (a).
I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

## PRIOR FOREIGN APPLICATION(S)

| COUNTRY | APPLICATION NUMBER | DATE OF FILING (day, month, year) | PRIORITY Claimed Under 35 U.S.C. 119 |
|---|---|---|---|
| GREAT BRITAIN | 9900910.2 | 16-01-1999 | Yes X No ____ |
| GREAT BRITAIN | 9911622.0 | 20-05-1999 | Yes X No ____ |
| GREAT BRITAIN | 9915569.9 | 02-07-1999 | Yes X No ____ |
| GREAT BRITAIN | 9922575.7 | 24-09-1999 | Yes X No ____ |

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35 United States Code §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

## PRIOR UNITED STATES APPLICATION(S)

| APPLICATION SERIAL NUMBER | FILING DATE | STATUS (PATENTED, PENDING, ABANDONED) |
|---|---|---|
| | | |
| | | |

SCANNED 7

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

**POWER OF ATTORNEY:** As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

Jack E. Haken, Reg. No 26,902
Algy Tamoshunas, Reg. No 27,677

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| Dated: 26 Nov 99 | | Inventor's Signature: Timothy J Moulsley | | |
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| FULL NAME OF INVENTOR | Last name | First Name. | Middle Name | |
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| Dated: | | Inventor's Signature: | | |
| FULL NAME OF INVENTOR | Last name | First Name | Middle Name | |
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| Dated: | | Inventor's Signature: | | |
| FULL NAME OF INVENTOR | Last name | First Name. | Middle Name. | |
| RESIDENCE & CITIZENSHIP | City | State or Foreign Country | Country of Citizenship | |
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of | Atty. Docket

MATTHEW P.J. BAKER ET AL. | PHB 34,314

Serial No. | Group Art Unit

Filed: CONCURRENTLY | Examiner:

Title: RADIO COMMUNICATION SYSTEM

Honorable Commissioner of Patents and Trademarks
Washington, D.C. 20231

## APPOINTMENT OF ASSOCIATES

Sir:

The undersigned Attorney of Record hereby revokes all prior appointments (if any) of Associate Attorney(s) or Agent(s) in the above-captioned case and appoints:

**JACK D. SLOBOD** **(Registration No. 26,236)**

c/o U.S. PHILIPS CORPORATION, Intellectual Property Department, 580 White Plains Road, Tarrytown, New York 10591, his Associate Attorney(s)/Agent(s) with all the usual powers to prosecute the above-identified application and any division or continuation thereof, to make alterations and amendments therein, and to transact all business in the Patent and Trademark Office connected therewith.

ALL CORRESPONDENCE CONCERNING THIS APPLICATION AND THE LETTERS PATENT WHEN GRANTED SHOULD BE ADDRESSED TO THE UNDERSIGNED ATTORNEY OF RECORD.

Respectfully,

Jack E. Haken, Reg. 26,902
Attorney of Record

Dated at Tarrytown, New York
this 6TH day of January, 2000.

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